User's Guide for TPS61183EVM-528 and TPS61187EVM-528

This user's guide describes the characteristics, operation, and use of the TPS61183 evaluation module (EVM). This EVM contains Texas Instruments' either the TPS61183 or TPS61187 IC configured as a WLED power solution providing up to six independently regulated current outputs using a single inductor step-up (boost) converter. The current outputs are ideal for driving a WLED backlight in notebook/laptop computers. This user's guide includes EVM specifications, recommended test setup, test results, bill of materials, and a schematic diagram.

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1 Applications

Notebook and Monitor LCD display backlight

2 TPS61183/7EVM-528 Electrical Performance Specifications

Table 1 provides a summary of the TPS61183/187EVM-528 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. TPS61183/7EVM-528 Electrical and Performance Specifications

Parameter		Notes and Conditions [1]	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
V_{IN}	Input Voltage		4.5		24	V
En	EN Logic high		2.1		20	V
PWM	PWM Logic high		2.1		20	V
I_{q_VIN}	Input quiescent Current	Device enable, switching 600 KHz and no load, V_{IN} = 21 V			4	mA
V_{IN_UVLO}	Input UVLO	V_{IN} ramp down			3.50	V
		V ramp up			3.75	
OUTPUT CHARACTERISTICS						
V_{OUT}	V(TP2)	J6 connected to 10 WLED configured WLEDEVM-260, JP5 shorted, JP6-13 shorted, EN/PWM =VDDIO, SEL=open		32	38	V
I_{OUT}	I(JP1) =6 X IFBx	V_{IN} = Min to Max, R1 = 62k		120		mA
SYSTEMS CHARACTERISTICS						
F_S	Switching Frequency	R_{FSW} = 499K	0.8	1	1.2	MHz

(1) The user can estimate the input current by solving the power balance equation, eff = P_{OUT}/P_{IN} = ($V_O \times I_O$)/($V_{IN} \times I_{IN}$), for I_{IN} and estimating the efficiency to be a conservative 85%. For example, for V_O = 32V, V_{IN} = 5V and I_O = 6 × 20mA = 120mA, I_{IN} = (32V × 120mA)/(5V × 0.85) = 0.904A

3 Modifications

See the appropriate IC datasheet when changing components such as R1 to set the LED current or R4 and R5 to set the OVP threshold. To aid in such customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space.

Note that changing components can improve or degrade EVM performance. For example, using inductors with larger dc resistance lowers the dc/dc converter's efficiency.

4 Connector and Test Point Descriptions

4.1 Input/Output Connections

The connections points are described in the following paragraphs.

4.1.1 J1 – VIN

This header is the positive connection to the input power supply. Twist the input supply and GND leads to the input supply and keep them as short as possible.

4.1.2 J2 – S+/S-

This header provides connection for the positive and negative sense leads for some power supplies. Connecting sense will help ensure proper regulation of the input voltage.

4.1.3 J3 – GND

This header is the return connection to the input power supply.

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4.1.4 J4 – 14-Pin Connector

This header facilitates connecting the EVM to the WLEDEVM-260 LED EVM boards. These boards must be ordered separately from the TPS61183/187EVM.

4.1.5 J5 – FPO

This header is the connection for the fault protection output that will indicate fault conditions including OVP, OC, and OT.

4.1.6 J6 – GND

This header connects to the board's ground plane.

4.1.7 J7 & J8 – GND

This header connects to the board's ground plane.

4.1.8 JP1 – LEDs ON

The user can remove the shunt on this jumper and connect the high side of external LED strings. When using the WLEDEVM-260 LED EVMs, installing the shunt on this jumper connects the output of the boost converter to J4. Removing the jumper removes the WLEDs from the boost converter feedback path and causes the IC’s over-voltage protection circuitry to activate. Instead of the shunt, the user can place an ammeter across the jumper to measure the total output current (i.e., 6×IFBx).

4.1.9 JP2 – EN-VDDIO

Installing the shunt on this jumper sets the ENABLE pin voltage to VDDIO, thereby enabling the IC's boost converter. Removing the logic high signal allows the internal pulldown resistor to pull EN to ground, which disables the IC's boost converter.

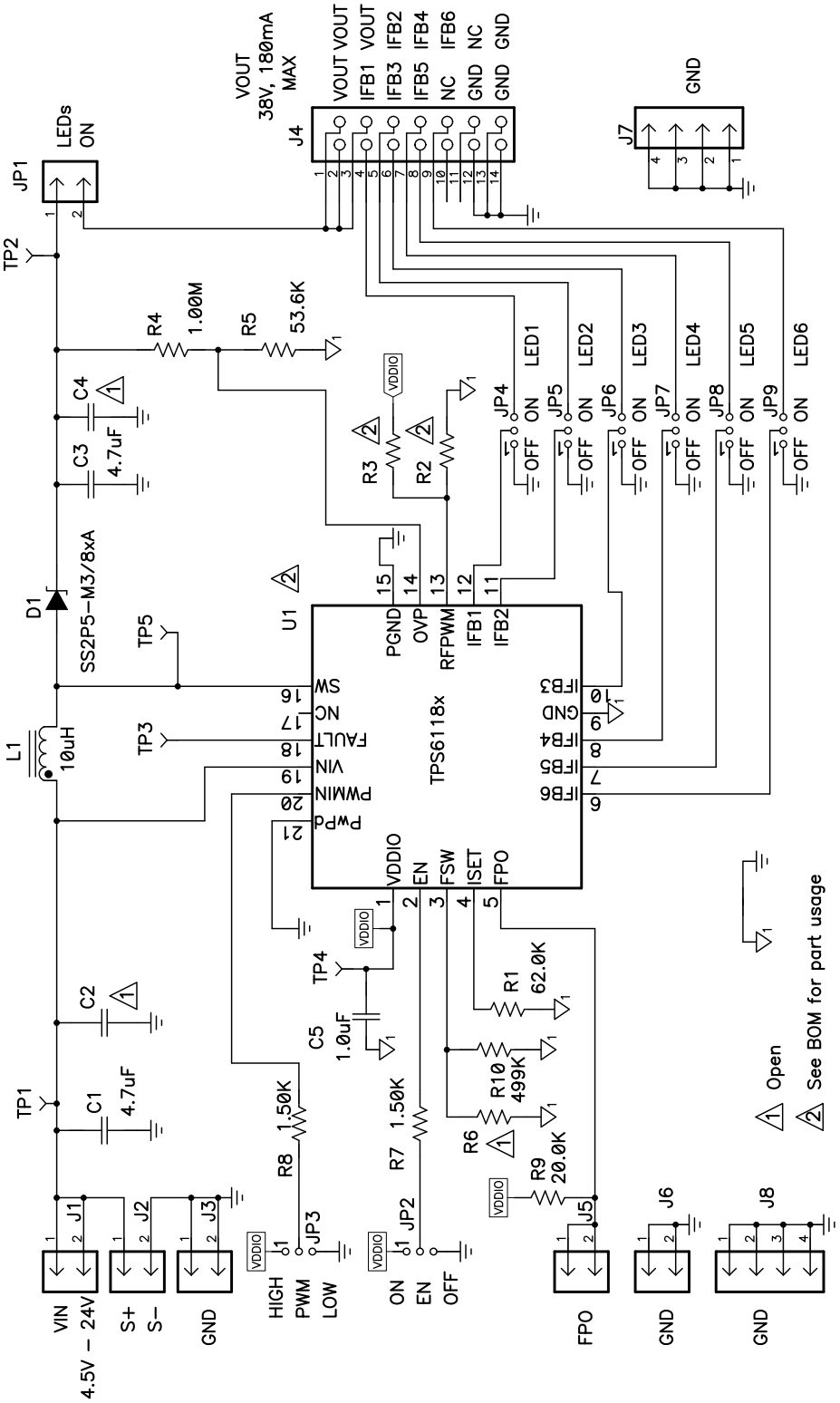
Note: With Vin applied, VDDIO/VDD does not reach full regulation until EN is pulled high. While it is possible to enable the IC by tying the EN pin to the unregulated VDDIO/VDD output for evaluation, it is not recommended in a real application.

4.1.10 JP3 – PWM-VDDIO

Installing the shunt on this jumper sets the PWM pin voltage to VDDIO, which sets the current sinks to 100% current and therefore any attached LEDs to full brightness. The user must connect an external PWM signal or use JP4 to take PWM to a logic high (above 2.1 V but no higher than 20 V) in order to enable the current sinks.

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5 Schematic and Bill of Materials



NOTE: For Reference Only, See Table 2 Bill of Materials for Specific Values

Figure 1. HPA528EVM Schematic

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Table 2. Bill of Materials

-001	-002	RefDes	Value	Description	Size	Part Number	MFR
1	1	C1	4.7uF	Capacitor, Ceramic, 25V, X7R, 10%	1206	Std	Std
0	0	C2	Open	Capacitor, Ceramic, 25V, X7R, 10%	1206	Std	Std
1	1	C3	4.7uF	Capacitor, Ceramic, 50V, X5R, 10%	1206	Std	Std
0	0	C4	Open	Capacitor, Ceramic, 50V, X5R, 10%	1206	Std	Std
1	1	C5	1.0uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	Std	Std
1	1	D1	SS2P5-M3/84A	Diode, High Current SMD Schottky Rectifier, 2A, 50VDC	DO-220AA	SS2P5-M3/84A or alt. SS2P6-M3/84A or alt. SS2P5-E3/84A or alt. SS2P6-E3/84A	Vishay
5	5	J1, J2, J3,J5, J6	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	1	J4	N2514-6002RB	Connector, Male Straight 2x7 pin, 100mil spacing, 4 Wall	0.100 inch x 2X7	N2514-6002RB	3M
2	2	J7, J8	PEC04SAAN	Header, Male 4-pin, 100mil spacing	0.100 inch x 4	PEC04SAAN	Sullins
1	1	JP1	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
8	8	JP2 – JP9	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	0.100 inch x 3	PEC03SAAN	Sullins
1	1	L1	10uH	Inductor, 90mohm DC resistance, ±20%	0.205 x 0.205 inch	#A915AY-100M	Toko
1	1	R1	62K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	R2	9.09k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	R3	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R4	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R5	53.6K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	0	R6	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	2	R7, R8	1.50K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R9	20.0K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R10	499K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	5	TP1, TP2, TP3, TP4, TP5	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	0	U1	TPS61187RTJ	IC, WLED Driver for Notebooks	QFN-20	TPS61187RTJ	TI
0	1	U1	TPS61187RTJ	IC, WLED Driver for Notebooks	QFN-20	TPS61187RTJ	TI
1	1			PCB, 1.75" x 3.5" x 0.062"		HPA528	Any
9	9	—		Shunt, 100-mil, Black	0.100	929950-00	3M

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6 Test Requirements and Setup

6.1 Hardware Requirements

This EVM requires an external power supply capable of providing up to 24V at 3A.

If dimming via an external PWM signal is desired, then a function generator capable of providing a PWM signal between 100 Hz to 22 kHz is required to avoid screen flickering and maintain dimming linearity.

6.2 Hardware Setup

- Connect a power supply capable of supplying up to 24 V at 3 A between the VIN pin and GND (J1 and J3). Do not turn on the power supply.
- JP1 should be connected directly or through an ammeter to the high side of external LED strings. Or, the shunt installed or replaced with an ammeter and the WLEDEVM-260 or WLEDEVM-461 connected to J4.
- Either use JP2 or connect a voltage source supplying at least 2.1-V but no more than 20-V signal to the high impedance EN pin (JP2) referenced to the same ground as J3.
- For PWM Dimming, either use JP3 or connect a second logic signal capable of providing at least 2.1-V but no more than 20-V signal to the PWM input.
- Properly configure JP4-JP9 so that each IFB line either connects directly to an LED string, to the J4 connector, or to GND. Unused IFBx lines should have the appropriate JP4-JP9 jumpers shunted to ground.

7 HPA528 Assembly Drawings and Layout

The following figures (Figure 2 through Figure 4) show the design of the TPS61183/7EVM-528 printed circuit board. The EVM has been designed using a 2-Layer, 2oz copper-clad circuit board 6.58 cm × 5.44 cm with all components in a 1.9cm × 2.2cm active area on the top side and all active traces to the top and bottom layers to allow the user to easily view, probe and evaluate the TPS61183/187 control IC in a practical double-sided application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space constrained systems.

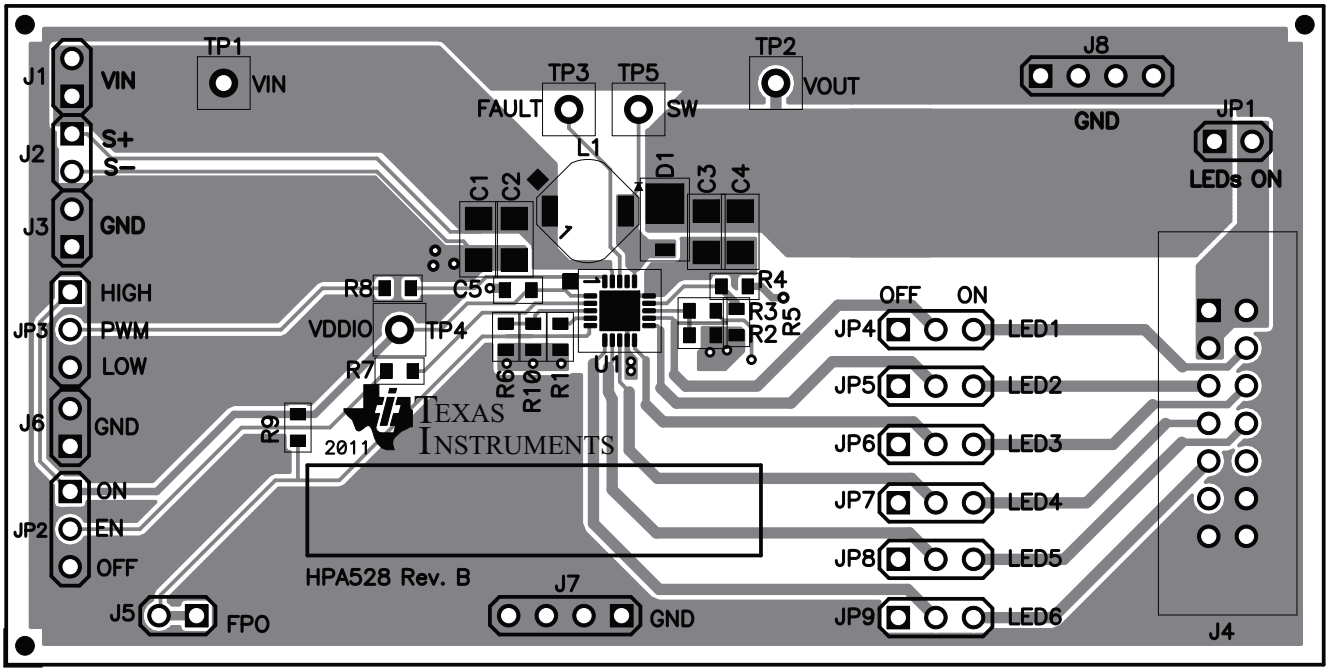


Figure 2. TPS61183/7EVM-528 Component Placement (Viewed from Top)

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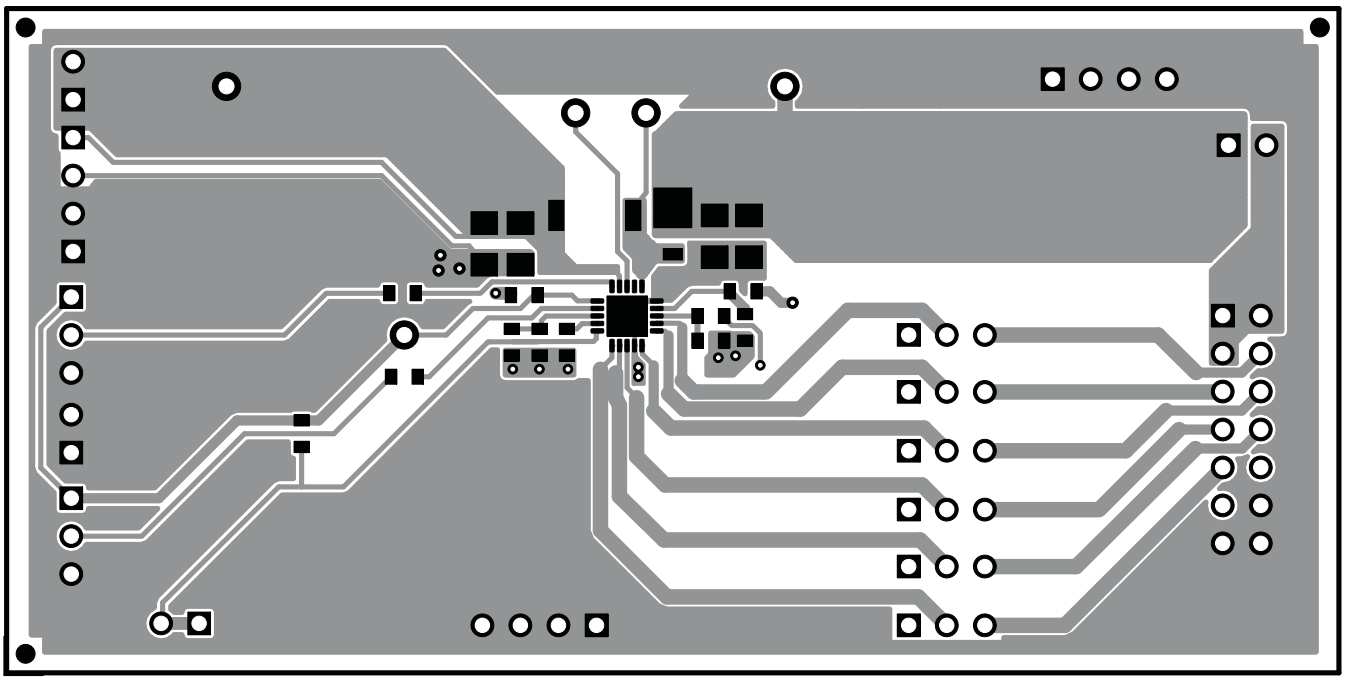


Figure 3. TPS61183/7EVM-528 Top Copper (Viewed from Top)

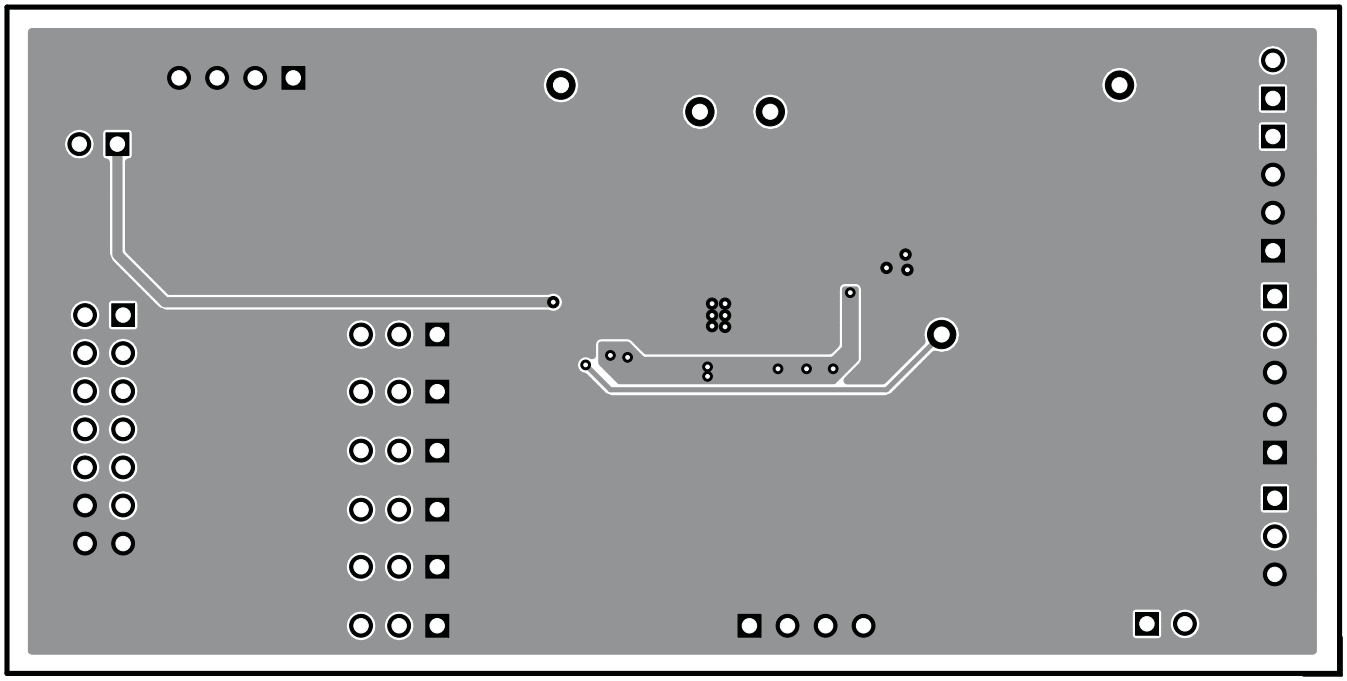


Figure 4. TPS61183/7EVM-528 Bottom Copper (Viewed from Bottom)

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For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

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